

NEXT-GENERATION SENSORS FOR THE OBJECTIVE FORCE

Douglas K. Wiltsie

Introduction

As the Army transforms itself into a faster and more versatile force, sensors will play a paramount role. Since their introduction during the Vietnam conflict, imaging sensors have grown significantly in their importance. This trend will continue. Even if future conflicts are fought in urban environments rather than in open areas, next-generation systems must allow objective forces to detect, locate, identify, and engage the enemy first.

Operation Desert Storm reinforced the importance of a comprehensive and effective night vision program. However, the meaning of night vision is no longer related simply to night operations. It has evolved into a day or night, all-weather, and all-terrain capability for any environment. For example, Future Combat Systems (FCS) will employ multiple sensors to develop an information awareness hemisphere for future soldiers, serving as eyes, ears, and sense of touch for the FCS unit. Futuristic unmanned ground vehicles (UGVs), unmanned aerial vehicles (UAVs), and unattended ground sensors (UGSs) will host multiple integrated sensors for target detection, location, and identification. Significant focus is also being placed on military operations on urbanized terrain, which has become the preferred tactical environment for low-technology adversaries, as demonstrated in Somalia and Chechnya. To respond effectively, next-generation sensors must operate in urban settings where thermal and reflective environments can be highly dynamic and where limited line of sight can diminish current technology advantages. Our goal, therefore, will

be to provide a proper mix of next-generation systems appropriate for any environment, urban or rural.

To meet these challenges, a variety of high-performance multispectral sensors, uncooled forward looking infrared (FLIR) sensors, short wavelength infrared (SWIR) systems, and multi-function lasers (MFLs) are being developed for next-generation systems. These newer technologies can also be used to improve range performance, reduce weight, or improve battery life on legacy and interim systems. The Office of the Project Manager, Night Vision/Reconnaissance, Surveillance and Target Acquisition (PM, NV/RSTA) at Fort Belvoir, VA, and its technology partner, the U.S. Army Communications-Electronics Command's Night Vision Electronic Sensors Directorate, are joined in a mutual quest for technology transitions that meet future warfighter needs.

Technology Breakthroughs

Uncooled FLIR Technology. Small, uncooled thermal sensors offer the Army low- to medium-performance alternatives that are cost effective, lightweight, and low powered (uncooled FLIRs are specifically either ferroelectric or microbolometer devices). These sensors are currently applied in rifle sights and drivers' viewers, but futuristic applications include the Enhanced Night Vision Goggle (ENVG) and the families of unattended ground imaging sensors. Applying new technologies to multiple products will reduce costs and capitalize on economies of scale in manufacturing. One attractive characteristic of uncooled technology is the elimination

of the need for a mechanical scanner and cryogenic cooler, two components with relatively low reliability. Even though early versions of these systems may still require thermoelectric coolers, they will draw significantly less power.

Manportable MFLs. To reduce the number and type of manportable lasers, the Army is considering two technologies now available that provide MFL capability in a single system. Laser diodes or a monoblock laser (a laser rod that integrates the reflectors and wave-shifting materials into a single structure, thus eliminating the need for stand-alone parts) can provide a universal laser system capable of ranging, illuminating, aiming, and serving as the combat identification and Multiple Integrated Laser Engagement System (MILES) transmitter, all in one efficient, cost-effective system.

SWIR Technology. SWIR technology, operating in the 1.0-2.0 micron range, offers an extremely long-range target acquisition and surveillance capability at a relatively inexpensive unit cost. Potential systems will use a laser target illuminator coupled with a SWIR detector-based imager to capture imagery at extended battlefield ranges.

Image Intensifier (I2) Technology. I2 technology, which has long been the backbone of the U.S. Army's "own-the-night" strategy, is continuously updated to increase performance of legacy, interim, and objective forces at both ends of the operational spectrum. Improvements in image tube sensitivity provide better visual clarity in overcast starlight, which is one of the most challenging operational environments. For high light conditions, a gated

power supply is improving the resolution by a factor of three. Gated tubes turn on and off very rapidly. This eliminates degradation commonly associated with conditions at dusk or dawn and those associated with urban nocturnal light pollution.

Current And Future Systems

Thermal Sights. The Thermal Weapon Sight (TWS) will be the first rifle sight to benefit from the insertion of uncooled technology. It will replace earlier TWS systems using second generation scanning focal plane arrays (FPAs). With the development of the uncooled focal plane, a very light (2-pound) TWS will soon augment the Army's inventory of medium-weight and heavyweight TWS systems. Uncooled FPAs will not be limited to the light TWS. Focal planes that are 240 by 320 pixels perform well enough to meet either the light- or medium-system range requirements. However, to fully meet medium-range requirements, larger telescope optics are necessary. For the heavy TWS, a larger 480 by 640 pixel array is being developed to meet long-range requirements. The potential to reduce a heavy TWS system's weight by 30 percent and reduce power consumption by 70 percent is realistic and achievable.

Drivers' Viewers. Thermal drivers' viewers were the first systems fielded using uncooled thermal technology. The Army's Driver Vision Enhancer (DVE) is in production for a multitude of U.S. vehicles. Improvements occurring in uncooled detectors will increase DVE performance in two ways: higher detector sensitivity will help drivers locate "hard-to-find" targets, and larger detector arrays will significantly improve system resolution. By adding an I2 camera, the Army increases the driver's ability to operate in all battle conditions.

Future Goggle Technology For Dismounted Troops. For dismounted soldiers, PM, NV/RSTA is developing the ENVG, which will eventually replace PVS-7 and PVS-14 NVGs. The ENVG will employ an uncooled thermal detector and the latest I2 tubes available, providing fused sensor imagery in a single system. I2 and FLIR images are overlaid in front of the human eye. The brain unconsciously fuses the images into a single clear image, giving the

operator a significantly improved detection capability. Sensor fusion was chosen over image fusion because current display and detector technology cannot provide the same level of resolution now achievable with a direct-view system.

The current dismounted infantryman must now carry several laser devices. This is part of their proverbial "100 pounds of light stuff." Therefore, the first MFL will be configured in a single multipurpose dismounted version for range finding, illuminating, aiming, and serving as the combat identification and MILES transmitter. The MFL will be mounted on either an individual or crew-served weapon. The MFL supports the Land Warrior or operates as a stand-alone system. Integrating these features into a single device will reduce a soldier's "carry weight" from 4 pounds to 1 pound and reduce the size from 100 cubic inches to 14 cubic inches.

FCS Sensors. The FCS sensors must provide sufficient information to create a hemisphere of situational awareness around them. To meet this goal, FCS will use a high-performance, vehicle-mounted Target Acquisition Sensor Suite to perform a rapid wide-area search and to acquire targets at long range. A less expensive family of disposable systems will also be developed for detecting targets at shorter ranges. These latter devices are ideal for inexpensive unmanned sensors such as small UAVs and UGVs, which wait, watch, and listen to provide essential situational awareness for the battlefield commander.

High-Performance Sensors. High-performance sensors will work in coordination with the unmanned sensors to provide an omniscient information hemisphere surrounding the FCS platform in a blanket of situational awareness. To meet the FCS' first unit equipped (FUE) 2010 requirement, the design for these sensors must leverage sensor improvements being developed for the Future Scout Cavalry System. The primary sensor will be the second generation FLIR. However, high-performance sensors will also incorporate a day TV; moving target indicator radar; laser illuminator, rangefinder, and designator; SWIR camera, and aided target recognition algorithm to improve cueing. It will allow our soldiers to operate undetected and to

identify the enemy over a large (180-360 degree) field of regard.

The Army is drafting the specifications for third generation FLIR, but funding is not yet available. If funded, third generation FLIRs would not be available for production until 2012; thus, not meeting the 2010 objective force FUE. However, third generation FLIRs could be incorporated later as a product improvement.

Network Sensor Capability. Network sensors for the objective force will be a combination of UGSs, UAVs, and UGVs, which will form the FCS perimeter of eyes, ears, and touch. The UGSs will use a seismic, acoustic, and low-performance thermal camera to detect, classify, and transmit an image to the control station. The sensors on the UAV and the UGV will depend on the mission requirement and the need for high or low performance, but could use a FLIR, day TV, or rangefinder sensor or the SWIR illumination system.

Conclusion

New imaging sensors are a lynchpin in the Army's transformation strategy and an enabling technology to meet objective force mission needs. U.S. sensor dominance will translate to information dominance on the digital battlefield. Initiatives described here, as well as parallel programs such as the Comanche and Apache helicopters and payloads for the Tactical UAV, will play a vital role in the Army's transformation. The path ahead must not only focus on performance but also on methods to make future devices cost effective. Using horizontal technology integration and omnibus contracting will ensure that the Army not only maintains its technological advantage but also obtains these devices at the best price.

DOUGLAS K. WILTSIE is the Technical Director for PM, NV/RSTA. He has a B.S. degree in mechanical engineering from Virginia Polytechnic Institute and State University, is a member of the Army Acquisition Corps, and is Level III certified in program management and systems planning, research, development and engineering.
